

Amendments to the Claims

Please amend Claims 1, 14, 41, 54 and 63. The Claim Listing below will replace all prior versions of the claims in the application:

Claim Listing

1. (Currently Amended) A method of controlling a surgical instrument that is inserted in a patient for facilitating a surgical procedure and controlled remotely from an input device manipulated by a surgeon at a user interface, said method comprising the steps of:
 - initializing the position of the surgical instrument without calculating its ~~original~~ initial position, and the position of the input device under electronic control;
 - said initializing including establishing an initial reference position for the input device and an initial reference position for the surgical instrument calculating the current ~~absolute~~ position of the input device as it is manipulated by the surgeon;
 - determining the desired position of the surgical instrument based upon;
 - the current position of the input device,
 - the initial reference position of the input device, and
 - the initial reference position of the surgical instrument, and
 - moving the surgical instrument to the desired position so that the position of the surgical instrument corresponds to that of the input device.
2. (Original) A method as set forth in claim 1 wherein the input device has position sensors, and the step of initializing includes these position sensors.
3. (Original) A method set forth in claim 2 wherein the initializing is to zero.
4. (Original) A method as set forth in claim 1 including computing an initial reference orientation for the input device.

5. (Original) A method as set forth in claim 4 including computing a desired orientation for the surgical instrument.
6. (Original) A method as set forth in claim 5 including computing a desired position for the surgical instrument.
7. (Original) A method as set forth in claim 1 wherein said initializing step includes performing a forward kinematic computation from the input device.
8. (Original) A method as set forth in claim 2 including reading position sensor values and current time.
9. (Original) A method as set forth in claim 8 wherein the calculating step includes calculating both the position and orientation of the input device.
10. (Original) A method as set forth in claim 1 including calculating the current orientation of the input device.
11. (Original) A method as set forth in claim 1 wherein said step of determining includes performing an inverse kinematic computation.
12. (Original) A method as set forth in claim 1 wherein said determining step includes a transformation into an earth coordinate system.
13. (Original) A method as set forth in claim 12 wherein from said transformation there are determined joint angles and drive motor angles for the surgical instrument orientation.
14. (Currently Amended) A method of controlling a tool of a surgical instrument that is inserted in a patient for carrying out a surgical procedure and is controlled remotely by

way of ~~a~~ an electronic controller from an input device at a user interface, said method comprising the steps of:

setting the input device at an initial reference configuration and under electronic controller control;

setting the surgical instrument in the patient at an initial predefined reference configuration without electronic controller control;

calculating the current absolute position of the input device;

determining the desired location of the tool by a kinematic computation that accounts for at least the initial reference configuration of the input device and the current absolute position of the input device; and

moving the surgical instrument to the desired position so that the location of the tool corresponds to that of the input device.

15. (Original) A method as set forth in claim 14 wherein said step of determining is also based upon the initial reference configuration of the tool.
16. (Original) A method as set forth in claim 14 wherein the input device has position sensors, and the step of setting includes initializing these position sensors.
17. (Original) A method as set forth in claim 14 including computing an initial reference orientation for the input device.
18. (Original) A method as set forth in claim 14 including computing a desired orientation for the surgical instrument.
19. (Original) A method as set forth in claim 14 wherein said calculating step includes performing a forward kinematic computation from the input device.
20. (Original) A method as set forth in claim 14 including calculating the current orientation of the input device.

21. (Original) A method as set forth in claim 14 wherein said step of determining includes performing an inverse kinematic computation.
22. (Original) A method as set forth in claim 14 wherein said determining step includes a transformation into an earth coordinate system.
23. (Original) A method as set forth in claim 22 wherein from said transformation there are determined joint angles and drive motor angles for the surgical instrument orientation.

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41. (Currently Amended) A method of controlling a medical implement remotely from an input device that is controlled by an operator, said method comprising the steps of:
- positioning the medical implement at an initial start position at an operative site for the purpose of facilitating a medical procedure;
 - establishing a fixed position reference coordinate representative of the initial start position of said medical implement based upon a base point of the implement and an active point of the implement being in a an initial known relative dimensional configuration,
 - positioning the input device at an initial start position;
 - establishing a fixed position reference coordinate ~~representative of the initial start position of said input device;~~
 - calculating the current position of the input device as it is controlled;
 - determining the desired position of the medical implement based upon;
 - the current position of the input device,
 - the fixed position reference coordinate of the input device, and
 - the fixed position reference coordinate of the medical implement, and
 - moving the medical implement to the desired position so that the position of the medical implement corresponds to that of the input device.

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42. (Original) A method as set forth in claim 41²⁴ wherein, in said step of positioning the medical implement, the medical implement comprises a surgical instrument.
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43. (Original) A method as set forth in claim 42²⁵ wherein, in said step of positioning the medical implement, the medical implement comprises a catheter.
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44. (Original) A method as set forth in claim 41²⁴ wherein said step of positioning the medical implement includes physically placing the distal end of the medical implement at the operative site.
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45. (Original) A method as set forth in claim 44²⁷ wherein said medical implement is placed without pre-computation of a coordinate position at which it is placed.
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46. (Original) A method as set forth in claim 45²⁸ wherein said step of positioning the medical implement is only controlled by manual placement without any electric pre-computation of a predetermined coordinate position to control the actual placement of the medical implement.
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47. (Original) A method as set forth in claim 41²⁴, wherein, in said step of positioning the medical implement, the medical implement comprises a surgical instrument having a tool and a wrist, said established reference coordinate corresponding to an initial position of a location on said wrist.
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48. (Original) A method as set forth in claim 41²⁴ further including providing an electronic controller for controlling said medical implement and wherein the step of positioning the medical implement includes manually placing the medical implement without computation by said controller of an initial coordinate position.

- 49.³² (Original) A method as set forth in claim 41²⁴ further including providing an electronic controller for controlling said medical implement and wherein the step of positioning the input device includes initially moving the input device under controller control so as to establish the reference coordinate position of the input device.
- 50.³³ (Original) A method as set forth in claim 42²⁵ including storing in the controller the reference coordinate position of the input device.
- 51.³⁴ (Original) A method as set forth in claim 41²⁴ wherein said step of establishing includes performing a forward kinematic computation.
- 52.³⁵ (Original) A method as set forth in claim 41³⁴ wherein said calculating step includes calculating both the position and the orientation of the input device.
- 53.³⁶ (Original) A method as set forth in claim 52³⁵ wherein said step of determining includes performing an inverse kinematic computation.
- 54.³⁷ (Currently Amended) A method of controlling a surgical instrument remotely from an input device and by way of an electronic controller, said method comprising the steps of:
- inserting the surgical instrument through an incision in the patient so as to dispose the distal end of the instrument at an initial start position;
 - establishing a fixed position reference coordinate system corresponding to a fixed predefined configuration of known position on the surgical instrument at the initial start position of said surgical instrument;
 - positioning the input device at an initial start position;
 - establishing a fixed position reference coordinate system representative of the initial start position of said input device;
 - calculating the current absolute position of the input device as it is controlled;

determining the desired position of the surgical instrument based upon the current absolute position of the input device, and the fixed position reference coordinate system for the respective surgical instrument and input device; and

moving the surgical instrument to the desired position so that the position of the surgical instrument corresponds to that of the input device.

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55. (Original) A method as set forth in claim ⁴⁷54 wherein said step of positioning the input device includes initializing the location of the input device under control of the controller.

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56. (Original) A method as set forth in claim ⁴⁸55 wherein said surgical instrument is initially positioned without control from said controller.

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57. (Original) A method as set forth in claim ⁴⁷54 wherein the initial start position is determined only by manual insertion.

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58. (Original) A method as set forth in claim ⁵⁰57 wherein the step of positioning the input device comprises initially moving the input device under controller control so as to establish the reference coordinate position of the input device.

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59. (Original) A method as set forth in claim ⁵¹58 including storing in the controller the reference coordinate position of the input device.

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60. (Original) A method as set forth in claim ⁴⁷54 wherein said step of calculating includes performing a forward kinematic computation.

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61. (Original) A method as set forth in claim ⁵³60 wherein said calculating step includes calculating both the position and the orientation of the input device.

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62. (Original) A method as set forth in claim ⁵⁴61 wherein said step determining includes performing an inverse kinematic computation.

~~63.~~⁵⁶ (Currently Amended) A method of controlling a medical implement remotely from an input device and by way of an electronic controller, said method comprising the steps of:

- inserting the medical implement through an incision in a patient so as to dispose the medical implement in a pre-select initial configuration;
- assigning a fixed initial reference coordinate to a work element of the medical implement based upon a known dimension between said work element and a base of the medical implement and said preselected initial configuration;
- positioning the input device at an initial start position;
- establishing a fixed initial reference coordinate representative of the initial start position of the input device;
- calculating the current position of the input device as it is controlled;
- determining the desired position of the medical implement based upon at least the current position of the input device; and
- moving the medical implement so that the position thereof corresponds to that of the input device.

~~64.~~⁵⁷ (Original) A method as set forth in claim ~~63~~⁵⁶ wherein said step of inserting the medical implement includes inserting a surgical instrument.

~~65.~~⁵⁸ (Original) A method as set forth in claim ~~63~~⁵⁶ wherein said step of inserting the medical implement includes inserting a catheter.

~~66.~~⁵⁹ (Original) A method as set forth in claim ~~63~~⁵⁶ wherein said step of inserting the medical implement includes inserting a distal end of the medical implement through the incision so as to be disposed at a target site.

~~67.~~⁶⁰ (Original) A method as set forth in claim ~~63~~⁵⁶ wherein said step of inserting the medical implement includes placing the medical implement without pre-computation of a coordinate position at which it is placed.

- ~~68~~⁶¹. (Original) A method as set forth in claim ~~63~~⁵⁶ wherein said step of assigning includes placing the medical implement without pre-computation to determine a coordinate position.
- ~~69~~⁶². (Original) A method as set forth in claim ~~63~~⁵⁶ wherein said step of establishing a fixed initial reference coordinate for the input device includes executing a forward kinematic computation to determine the reference coordinate.
- ~~70~~⁶³. (Original) A method as set forth in claim ~~69~~⁶² wherein said step of executing a forward kinematic computation includes determining both the position and orientation of the input device.
- ~~71~~⁶⁴. (Original) A method as set forth in claim ~~69~~⁶² wherein said step of executing a forward kinematic computation includes determining a position by a geometric calculation.
- ~~72~~⁶⁵. (Original) A method as set forth in claim ~~71~~⁶⁴ including determining an orientation by a transformation matrix.
- ~~73~~⁶⁶. (Original) A method as set forth in claim ~~63~~⁵⁶ wherein said step of determining includes performing an inverse kinematic computation.
- ~~74~~⁶⁷. (Original) A method as set forth in claim ~~73~~⁶⁶ including determining joint angles and insertion length of the instrument.
- ~~75~~⁶⁸. (Original) A method as set forth in claim ~~74~~⁶⁷ including determining the instrument orientation.

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94. (Previously Presented) The method as set forth in claim ²⁴41 wherein said step of establishing a fixed position reference coordinate representative of the initial start position of said medical implement includes establishing said reference coordinate in relation to the patients body.
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95. (Previously Presented) The method as set forth in claim ³⁷94 wherein the reference coordinate of the implement is at a predetermined location of the patient.
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96. (Previously Presented) The method as set forth in claim ³⁸95 wherein the predetermined location is at an incision.
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97. (Previously Presented) The method as set forth in claim ³⁸95 wherein the reference coordinate of the implement corresponds to an internal site of the patient..
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98. (Previously Presented) The method as set forth in claim ⁴⁰97 wherein the reference coordinate of the implement corresponds to a site external of the patient.
- ⁴²
99. (Previously Presented) The method as set forth in claim ²⁴41 wherein the step of establishing a fixed position reference coordinate representative of the initial start position of said medical implement includes aligning an axis of the base point of the medical implement with an incision in the patient.
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100. (Previously Presented) The method as set forth in claim ²⁴41 wherein the step of determining includes performing a coordinate transformation from the base point to the active point of the implement.
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101. (Previously Presented) The method as set forth in claim ⁴³100 wherein the coordinate transform is a fixed transform less than 90 degrees.

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~~102.~~ (Previously Presented) The method as set forth in claim ~~101~~⁴⁴ wherein the fixed transform is on the order of 45 degrees.

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~~103.~~ (Previously Presented) The method as set forth in claim ~~102~~⁴⁵ wherein the fixed transform on the order of 45 degrees corresponds to the curvature of the guide tube.